# Abundances of Carbon Monoxide, Formaldehyde, and Methyl Alcohol in Comets: Measuring Efficiencies for Conversion of CO in Grain Mantles

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Hydrogen addition to CO ice in grain mantles prior to their incorporation into comets has been proposed as a viable means of producing monomeric formaldehyde and methanol, a

process that has been verified in laboratory irradiation experiments on pre-cometary analog ices ($H_2O$:CO mixtures). The relative abundances of CO, $H_2CO$, and $CH_3OH$ in comets represents one measure of the conversion efficiency of CO, and provides information on extant conditions (e.g., H-atom densities) in the region of the proto-solar nebula where these comets formed. Using high-resolution echelle spectrometers, we have detected CO and $CH_3OH$ in ten Oort cloud comets, and at least four of these also exhibit definitive emission from $H_2CO$. We will report measured abundances and conversion efficiencies for several comets in our database.

The presence of formaldehyde and related molecules in comets can provide fundamental information pertaining to the origin of life. For example, $H_2CO$ not only is significant in its polymerization to sugar but, along with HCN and $NH_3$, is thought to play an important role in the synthesis of amino acids in primitive bodies such as the parent of the Murchison meteorite.

We also apply an existing fluorescence model for $H_2CO$ to line-by-line intensities in our comet spectra. This provides a constraint on the rotational temperature for comparison with that measured for other molecules (e.g., CO, HCN, $H_2O$), and permits more accurate retrieval of production rates.

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